# APPENDIX K

## DERIVATION OF VERTICAL SHEAR FORCE FOR UPWARD SLOPING BACKFILL

K-1. Derivation for Shear Required on Vertical Faces of Earth Wedges. When the vertical face of an earth wedge does not lie on the same plane as the face of the structural wedge, a shear force is required in order that the horizontal earth force may be transferred between wedges.

A general situation where such a force is required is shown below in Figure K-1.

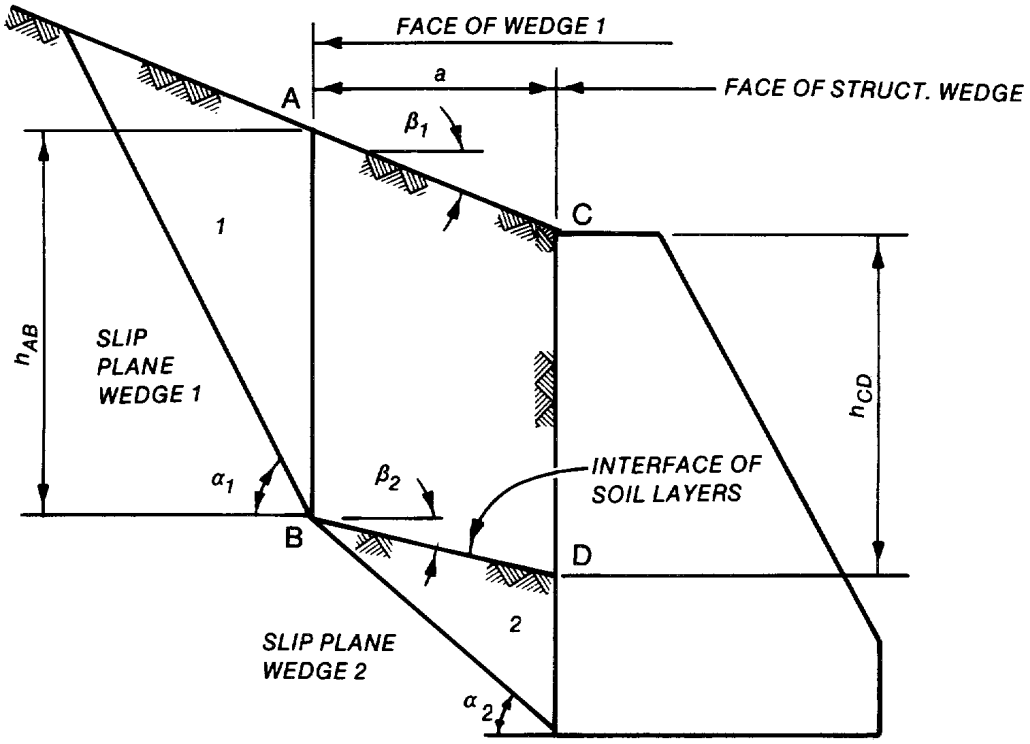


Figure K-1. General condition where shear force is required

The earth force calculated for wedge 1, using the provisions of the text, is a force acting on Surface AB. In order for the same force to act on Surface CD, a shear force must exist on vertical planes in Block ABCD. A free body of Block ABCD is shown in Figure K-2.

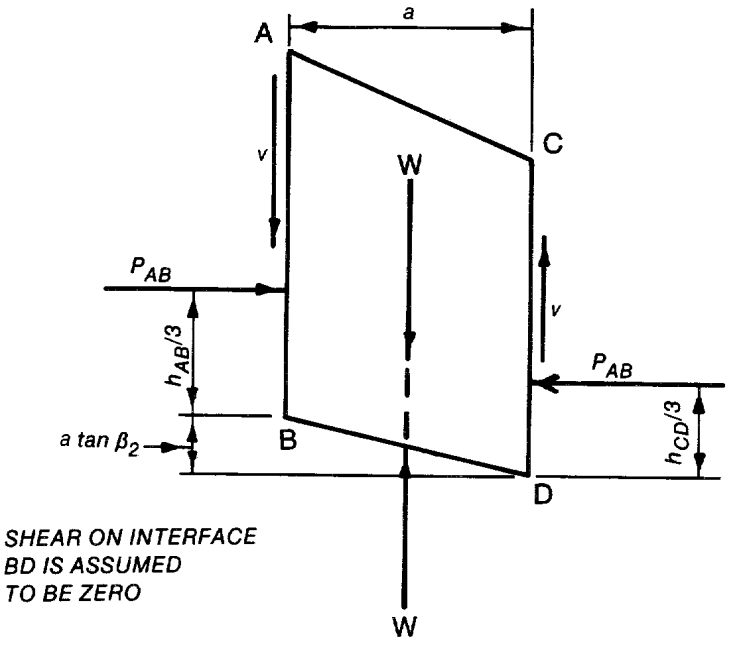


Figure K-2. Free body of Block ABCD.

Taking moments about D:

$$P_{AB}\left[\left(\frac{h_{AB}}{3} + a \tan \beta_2\right) - \frac{h_{CD}}{3}\right] - va = 0$$

where

$$h_{CD} = h_{AB} - a\,(\tan \beta_1 - \tan \beta_2)$$

then

$$P_{AB}\left(\frac{h_{AB}}{3} + a \tan \beta_2 - \frac{h_{AB} - a \tan \beta_1 + a \tan \beta_2}{3}\right) = va$$

$$P_{AB}\left(a \tan \beta_2 + \frac{a \tan \beta_1}{3} - \frac{a \tan \beta_2}{3}\right) = va$$

$$v = \frac{P_{AB}(\tan \beta_1 + 2 \tan \beta_2)}{3}$$

See example 6 in Appendix M and example 1 in Appendix N for applications of the above equation.